

Solid Earth Discuss., referee comment RC1  
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## Comment on se-2022-2

Anonymous Referee #1

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Referee comment on "Strain localized deformation variation of a small-scale ductile shear zone" by Lefan Zhan et al., Solid Earth Discuss., <https://doi.org/10.5194/se-2022-2-RC1>, 2022

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Review of manuscript se-2022-2.

Unfortunately, the paper cannot be accepted for publication in the present form, and I suggest rejection. My main concerns regard (1) the structure and readability of the whole text; (2) the relevance of the presented topic for Solid Earth journal, (3) sample characterization and data presentation. The presented topic might be better suited for another journal, maybe focussed on the regional geology of the region. In the following I will provide some general comments on the sections of the manuscript. Detailed comments can be found in the attached commented pdf file.

General comments.

Semantics and syntax of many sentences are rather complex, and some sentences are not understandable at all. A check of the sentence structure and meaning by a native English speaker would be advisable in this case. Language grammar and spelling are ok (some typos are still present though), but the structure of sentences and paragraphs make the manuscript very hard to follow and understand.

It is not clear how the proposed aims of the paper (Lines 85-89) can contribute to the research topic proposed in the Introduction. It is not clear either what the main research question is. As it is now the paper consists of a (average quality) EBSD and microstructural data collection, without any clear objective neither in the data presentation nor in the discussion section.

Abstract.

- One of the main points of the abstract regards the rate-limiting fluid-assisted mechanisms, which topic is just briefly discussed in the main text and would need to be unfolded and better discussed.

#### Introduction.

- The introduction presents a rather complete and up-to-date list of references and a general overview of the topics analysed in the following text. However, it is not clear what contribution the present manuscript yields to the described topics. What is the main research question? What are you aiming at with the description of small-scale shear zone? How come the results of your research work help to answer to the main research question?

- The aims of the paper reported at Lines 85-89 leave the readers asking themselves the unfortunate "so what" question.

#### Geological settings.

- The geological setting of the sample and host rock (age of emplacement, age of deformation, regional conditions of deformation) need to be better described. As it is now, we just know that the samples come from a granodiorite that preserves its magmatic texture. How old is it? Does it have undergone to any metamorphic cycle? Is just syn-shearing pluton emplacement along the GLG-SZ? This is critical to understand the formation conditions of the sample small-scale shear zones.

- Samples need to be properly located in the geological framework. The reader needs to understand if the presented analyses (microstructural description, EBSD, CL, microchemistry) come from the same sample or different samples. This is not clear at all in this manuscript.

#### Data presentation and figures.

- Mesoscale description. Ok but please consider rephrasing complex sentences.

- Microstructures. See detailed comments.

#### EBSD:

- It is not clear whether the EBSD maps come from the same sample, different samples or whatsoever.

- Contoured pole figures need to be presented as one-point-per-grain to be statistically meaningful. One-point-per-pixel pole figures are affected by the area (i.e., grain size translated in number of pixels) occupied by each grain, and thus they represent a biased dataset.

- "Negative/positive correlation between misorientation angle distributions": it is unclear what this sentence means in the context of distribution comparison.

P-T- estimation - Chemical data for Hbl-Pl

- The compositional data adopted for geothermobarometry are not presented in the text. Please, provide at least a table with the phase compositions. It would be also nice to discuss whether the adopted compositions are at the equilibrium during deformation or not.

- Is this really the emplacement depth? Could it be a re-equilibration metamorphic depth? Need to improve the description of the geological setting of the granodiorite from where the samples have been collected.

Grain sizes: it would be better to retrieve grain sizes from the EBSD dataset, and to adopt the same statistical parameter (mean, median) for the flow-stress computation as those adopted in the piezometric relationship here implemented (see Luan and Paterson 1992 and Hirth 2001 for the details).

Flow stress – Strain rate calculations.

- Temperature need to be properly constrained. There are several contradiction throughout the text regarding temperature of deformation. P-T conditions of emplacement are 650-750°C. Are not these the deformation conditions? Then you have to explain that after emplacement the granodiorite underwent some sort of cooling or exhumation. At Line 561, an arbitrary temperature of 550°C is chosen based on microstructural characteristics. Is this the temperature of deformation of the small-scale shear zone? Why then in the discussion you come back to 650-735°C to explain the development of "foliated" granodiorite (the granodiorite hosting the sample was described as non-foliated in the geological setting...).

- The arbitrary choices of both grain size and temperature deeply affect the flow-stress strain rate estimations.

Discussion regarding deformation mechanisms:

- The authors claim for the activation of certain deformation mechanisms without providing compelling evidence, even if they present a large EBSD dataset.

- The discussion regarding deformation mechanisms is confuse, complex and hard to follow. Among other comments, three main topics are of high concern: (i) dislocation creep activation in Kfs: the evidence provided for the activation of slip systems in the present paper might be due to the presentation of pole figures as one-point-per-pixel, which presentation obscures the real statistics of the pole figure; (ii) fluid-assisted deformation and reactions: this topic is not properly introduced and not even described in the data section. (iii) the following discussion about formation conditions and mechanisms need to be reviewed at the light of the comments above.

Please also note the supplement to this comment:

<https://se.copernicus.org/preprints/se-2022-2/se-2022-2-RC1-supplement.pdf>